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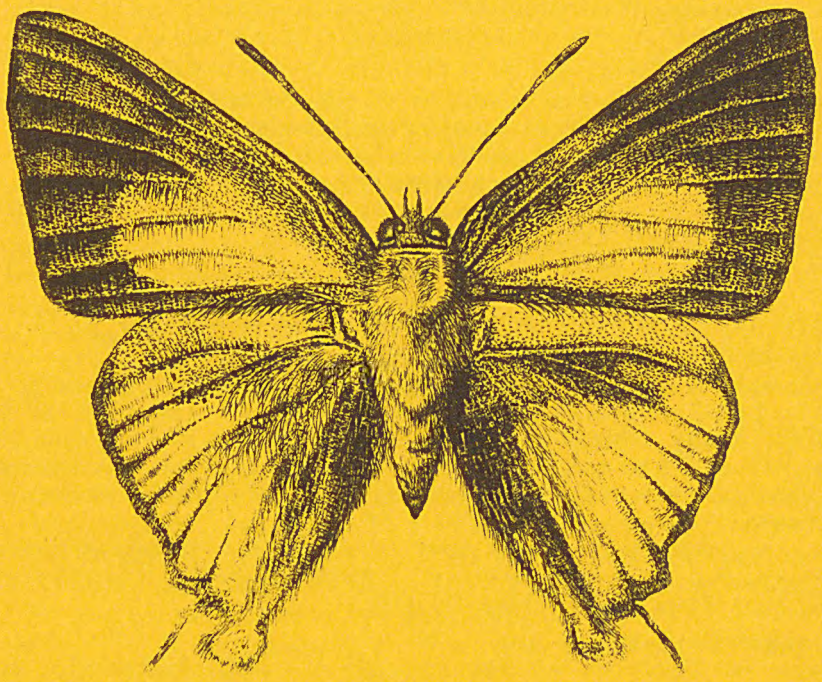

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Cover: The cornelian butterfly, *Deudorix epijarbas* (Moore) is distributed from Cape York, Qld south to the Gosford area, N.S.W. The male is strikingly coloured orange-red and black above and pale brown below. The larvae feed within the seed capsule of several rainforest plants, including *Harpullia, Macadamia* and *Buckinghamia.* From an original etching by Geoff Thompson.

NOTES ON "TYPES" OF THE AUSTRALIAN SPECIES OF THE *ROPALIDIA INTERRUPTA* COMPLEX (HYMENOPTERA: VESPIDAE: POLISTINAE)

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Abstract

Notes are provided on "types" of the following Australian taxa of the *Ropalidia interrupta* complex: *R. variegata interrupta* van der Vecht, *R. variegata flavinoda* van der Vecht, *R. mutabilis mutabilis* Richards and *R. mutabilis torresiana* Richards.

Introduction

In his monograph on the Australian social wasps, Richards (1978) treated *Ropalidia variegata interrupta* van der Vecht, 1941 as a valid full species and *R. variegata flavinoda* van der Vecht, 1941 as a subspecies of *interrupta*, and described *R. mutabilis* and its subspecies *torresiana* as a species closely related to *R. interrupta*. His conclusions, however, were not based on the examination of any types of *R. interrupta* or *R. flavinoda*. Richards (1978: 89) stated that the holotypes of *interrupta* and *flavinoda* 'should be at Harvard but could not be found, and may have been lost when Van der Vecht returned them by post in 1941'. Elsewhere (Kojima 1999), I revised the taxonomy of the Australian *Ropalidia* Guérin-Méneville and concluded that the holotypes of *R. variegata interrupta* and *R. variegata flavinoda* were in the Museum of Comparative Zoology, Harvard University, Cambridge (MCZ). I then treated both *R. interrupta* and *R. flavinoda* as full species and synonymized *R. mutabilis mutabilis* and *R. m. torresiana* respectively under *R. interrupta* and *R. flavinoda* after examining the holotypes of both of Richards' taxa housed in the Australian National Insect Collection, CSIRO, Canberra (ANIC).

A recent visit to the Nationaal Natuurhistorisch Museum, Leiden (NNM) revealed a number of specimens of the *R. interrupta* complex that are incorrectly or ambiguously labelled as types. These include a female labelled as a 'topotype' of *R. interrupta* and a "pseudotype" specimen which appears to match Richards' (1978) original description of *R. m. torresiana*. In order to avoid future nomenclatural confusion caused by this erroneous type labelling, I here give comments on and clarify the status of the "types" of the Australian species of the *R. interrupta* complex. When label data are quoted, a slash (/) denotes the beginning of a new line on the label.

Ropalidia variegata interrupta and *R. variegata flavinoda*

A female in the NNM labelled 'Thursday I./ Mar. 15/ A. Mackie/ + A. Foote [in handwriting]', 'No. 45 [in handwriting]', 'Museum Leiden/ ex. coll. J. v. d. Vecht [in print]', 'Paratype [in print on orange label]' and '*R. variegata* (Sm.)/ var. *interrupta* m./ det. J. v. d. Vecht '37 [in van der Vecht's handwriting]' is undoubtedly the paratype of *R. v. interrupta*. In the NNM there is another

female that is labelled, in addition to the same collection label as the paratype, with 'ac 32367 [in handwriting]', '*Ropalidia* [in print]/ *interrupta* ♀/ *interrupta* v d Vecht [in van der Vecht's handwriting]/ det. J. v. d. Vecht 1979 [in print, except last '9' in van der Vecht's handwriting]' and 'topotype [probably in van der Vecht's handwriting, on red label]'. This specimen is almost certainly not part of the type series. Van der Vecht (1941: 158) only listed two females for *R. variegata interrupta*, a paratype (the first female noted above in the NNM) and the holotype. Van der Vecht was presumably certain that he had sent the holotype to the MCZ, otherwise, he would not have labelled the second female specimen in the NNM 'topotype'. The specimens in the MCZ bearing the following labels should be treated as the holotypes of *R. v. interrupta* and *R. v. flavinoda* respectively: '*Ropalidia/ variegata* Sm./ subsp. *interrupta*?/ det. J. van der Vecht 1963' and '*Ropalidia/ variegata* (Sm.)/ subsp. *flavinoda* m/ det. J. van der Vecht 1963'. I interpret these labels to be of later origin, with van der Vecht's original labels having been replaced by someone in the MCZ (cf. Kojima 1999).

Ropalidia mutabilis mutabilis

The holotype of *R. mutabilis mutabilis* is in the ANIC and I could not find any specific differences between it and the holotype of *R.. interrupta* in the MCZ, and thus synonymized *R. mutabilis* under *R. interrupta* (Kojima 1999). Although I did not examine all of the paratypes of *R. mutabilis* in the ANIC, those that I examined agreed with the holotype. In the NNM, there are four females under '*Ropalidia mutabilis*'. Three females labelled 'Museum Leiden/ W. AUSTRALIA/ Windjana Gorge/ (Kimberley)/ 16-17.VIII.1968/ G. F. Mees', 'Paratype' and '*R. mutabilis/ mutabilis*/ Richards/ t Parat. [in Richards' handwriting]' (one female with the last label as '*R. mutabilis/ mutabilis*/ ♀ Parat. Richards') are certainly paratypes of *R. mutabilis*, though Richards (1978: 96) stated '1960' for the year of collection. The fourth specimen, labelled 'N. AUSTRALIA/ Port Darwin/ 19/ R. C. L. Perkins Coll./ B. M. 1942-95', 'Paratype', 'Museum Leiden/ ex collectie/ J. v. d. Vecht' and '*Ropalidia/ mutabilis*/ Parat Rich [in Richards' handwriting]' is a paratype of *R. mutabilis* indicated to be in the Natural History Museum, London (BMNH) in the original description. This specimen is darker, with reduced yellow markings, than the original description and might be one of the specimens that Richards (1978: 95) referred to as 'darker specimens which somewhat resemble *R. interrupta* also occur ...'. Richards may have sent this specimen to van der Vecht for confirmation or on exchange with the NNM specimens.

The NNM houses three females and a male under a manuscript name that has never been published. Two females and the male labelled 'Museum Leiden/ W. AUSTRALIA/ E. Kimberley/ Grottnr Wyndham/ 5.XII.1974/ G. F. Mees' and 'Museum Leiden/ *Ropalidia/ interrupta* ♀ [or ♂]/ *impressa* Rich./ det. J. v. d. Vecht 1975' were certainly not seen by Richards. Van der Vecht might

have identified them based on comparison with the last specimen, which is labelled 'Museum Leiden/ W. AUSTRALIA/ Mount House/ (Kimberley)/ 3.VIII.1968/ G. F. Mees', 'Paratype' and '*Ropalidia/ interrupta* v. d. V./ spp. *impressa*/ ♀ Parat. Rich. [in Richards' handwriting]'. This specimen may well be a paratype of *R. mutabilis* as Richards (1978: 96) listed a female with the same collection data except for a date of '3.vi.1968'.

All the female specimens placed under '*mutabilis*' and the unpublished manuscript name in the NNM did not show any specific differences from the types (holotype and paratype) of *R. interrupta*.

Ropalidia mutabilis torresiana

The holotype from Iron Range and a paratype from Somerset of *R. m. torresiana* are in the ANIC. Richards listed two other females from Torres Strait as paratypes and indicated the National Museum of Victoria, Melbourne (NMV) as the depository. I have not seen these paratypes in the NMV, while the holotype and paratype in the ANIC generally agreed with the holotype of *R. flavinoda* both in structure and coloration. On the other hand, the types of *R. m. torresiana* in the ANIC differed from Richards' original description in marking pattern; notably he referred to a yellow marking on the first metasomal tergum only as 'a pre-apical band', while the widened part of the first metasomal tergum of the holotype (and a paratype in the ANIC) is largely yellow.

In the NNM there is a single female specimen deposited under '*Ropalidia mutabilis torresiana*'. The specimen belongs to *R. interrupta* and is labelled 'AUSTRALIA/ Banks Is.,/ Torres Strait/ 12 February 1974/ J. P. Spradbery, Paratype' and '*R. mutabilis*/ ssp. R /*torresiana* R/ ♀ Paratype [in Richards' handwriting]'. The specimen is not a paratype of *R. m. torresiana*, as Richards mentioned neither Banks Island as a locality nor Spradbery as a collector. On the other hand, the specimen agrees, in most aspects, with Richards' original description of *R. m. torresiana*. It seems clear that the original description of *R. m. torresiana* was based on this "pseudotype" in the NNM (or possibly additional "pseudotypes" in the BMNH, though I have not seen such specimens in the BMNH) and not on the types deposited in the Australian institutions. I (Kojima 1999) pointed out a similar case for *R. eurostoma* Richards, 1978, of which the original description was undoubtedly based on the paratypes in the BMNH, not on the holotype and a paratype in the South Australian Museum, Adelaide (SAM); they belong to different species, the SAM specimens to *R. revolutionalis* (de Saussure, 1854) and the BMNH specimens to *R. interrupta*.

In conclusion, the synonymies of *R. mutabilis mutabilis* and *R. m. torresiana* respectively under *R. interrupta* and *R. flavinoda* are confirmed. Taxonomic points still unsolved are the relationships of *R. interrupta* and *R. flavinoda* to the Asian species *R. variegata* (Smith, 1852) and *R. jacobsoni* (du Buysson, 1908) (cf. Kojima 1999).

Acknowledgments

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References

KOJIMA, J. 1999. Taxonomic notes on Australian *Ropalidia* Guérin-Méneville, 1831 (Hymenoptera: Vespidae, Polistinae). *Entomological Science* **2**: 367-377.

RICHARDS, O.W. 1978. The Australian social wasps (Hymenoptera: Vespidae). *Australian Journal of Zoology, Supplementary Series* **61**: 1-132.

van der VECHT, J. 1941. The Indo-Australian species of the genus *Ropalidia* (= *Icaria*) (Hym., Vespidae) (first part). *Treubia* **18**: 103-190.

FIRST RECORD OF *PAPILIO MEMNON* L. (LEPIDOPTERA: PAPILIONIDAE) FROM CHRISTMAS ISLAND, INDIAN OCEAN

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Abstract

Papilio memnon L. is recorded from Christmas Island for the first time. Its wide distribution across the island and the presence of both sexes suggests this large butterfly is breeding on the island.

Introduction

Christmas Island lies in the tropics some 360 km to the south of the Indonesian island of Java. It has an area of approximately 137 sq km and supports a lush tropical rainforest. It is particularly interesting biologically because of its continued isolation from other land masses since it first began emerging from the sea some 10 mya.

The butterflies of Christmas Island have been documented in detail by Moulds and Lachlan (1987). Twenty-two species were recorded but only one papilionid, *Papilio demoleus* L., was included. Here we record the presence of a second papilionid, *Papilio memnon* L.

Christmas Island records

During field work on Christmas Island in November 1999, we took two males of *Papilio memnon* at Grants Well, near the centre of the island, on the 20th and 22nd respectively. Other males were seen at Grants Well, in addition to others near the Central Area Workshop and near the sewage treatment works at Smith Point. A female was also sighted at the latter location.

The two males captured conform to the nominate subspecies distributed through Borneo, Banka, Bawean, Bali and Java, and resemble the specimen figured by Tsukada and Nishiyama (1982: pl. 122, figs 1, 2) except that the subterminal row of spots on the underside of the hind wing do not, for the most part, merge with the basal coloration. The female was dominantly white and appeared similar to that figured by Tsukada and Nishiyama (1982: pl. 123, figs 3, 4). *Papilio memnon* is generally considered a common species and well known for its leisurely flight. However, all males encountered on Christmas Island flew rapidly and were extremely difficult to catch. The sighted female appeared less active but it was encountered on only one occasion, despite repeated visits to the location.

Discussion

It is not altogether unexpected that such a large butterfly, common through Indonesia and capable of strong flight, should reach Christmas Island. The larvae feed on Rutaceae, including *Citrus*, and would probably have little

trouble establishing, especially since human colonisation and the introduction of *Citrus aurantifolia* (Christm.)Swingle (lime), *C. maxima* (Burm.)Merr. (pomelo), *C. microcarpa* Bunge and *Clausena excavata* Burm.f. These are all likely foodplants, the latter having been recorded as a host in Java by Dupont and Scheepmaker (1936).

It is difficult to know whether *P. memnon* was resident on Christmas Island prior to human colonisation, beginning in 1888. Only three species of Rutaceae possibly occur naturally on Christmas Island, *Acronychila trifoliolata* Zooll. & Moritzi var. *trifoliolata*, *Murraya paniculata* (L.) Jack, and *Triphasia trifolia* (Burm.f.) P. Wilson (Du Puy 1993). None of these has been recorded as a foodplant of *P. memnon*. Therefore, it is most likely that *P. memnon* has established since the introduction of *Citrus* and the accidental introduction of eggs, larvae or pupae on potted *Citrus* cannot be ruled out.

Acknowledgment

We wish to thank the Department of Environment and Heritage, Environment Australia, for permission to collect insects on Christmas Island.

References

DUPONT, F. and SCHEEPMAKER, G.J. 1936. *Uit Java's vlinderleven.* Bibliotheek van de Nederlandsch-Indische Natuur-historische vereeniging VII. Boekhandel and Visser, Batavia; 216pp.

DU PUY, D.J. 1993. Christmas Island. In *Flora of Australia*, Volume 50, Oceanic islands 2. Australian Government Publishing Service, Canberra; pp 1-30.

MOULDS, M.S. and LACHLAN, R.B. 1987. The butterflies (Lepidoptera) of Christmas Island, Indian Ocean. *Australian Entomological Magazine* **14**(4,5): 57-66.

TSUKADA, E. and NISHIYAMA, Y. 1982. *Butterflies of the south east Asian islands.* I. *Papilionidae*. English edition. Plapac, Tokyo, Japan; 457 pp, 166 pls.

ANT ATTENDANCE AND NOCTURNAL FEEDING OF THE LEAFHOPPER *SMICROCOTIS OBSCURA* KIRKALDY (HEMIPTERA: CICADELLIDAE: LEDRINAE)

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Abstract

Smicrocotis obscura Kirkaldy feeds at night and is tended by ants of the genus *Camponotus*. Details of the ant-hemipteran association and the taxonomy of *Smicrocotis* Kirkaldy are discussed and compared with other known ant associations within related groups. *Smicrocotis sidnica* Kirkaldy is newly synonymised with *S. obscura*.

Introduction

Stenocotini is a tribe of relatively primitive leafhoppers currently containing six genera and 12 species, all confined to Australia and all feeding on the stems and branches of *Eucalyptus* (Evans 1966).

Smicrocotis was erected by Kirkaldy (1906) to contain a single adult female leafhopper from Cairns, Queensland, which he named *Smicrocotis obscura* Kirkaldy. Kirkaldy (1906) also mentioned a nymph from Sydney, NSW which he assumed belonged to the same species. He later named a second species, *S. sidnica* Kirkaldy, based on a male also from Sydney (Kirkaldy 1907). Distant (1907) described three species which Evans (1966) subsequently synonymised with *S. obscura*. Evans (1937, 1947) described two additional species in the genus, *S. solomoni* Evans from Crawley, WA and *S. brunneus* Evans from Sydney, NSW. Evans (1966) stressed that, because of sexual dimorphism and variation in colour and size, more material was needed before species limits could be determined with confidence.

Smicrocotis species have been recorded from a number of localities in all Australian States but no behaviour has been described.

Observations

During a visit to Orange, NSW, during 22-26 February 1997, the senior author observed numbers of the common sugar ant, *Camponotus consobrinus*, both large headed and normal workers, aggregating after sunset on the trunks of several species of young eucalypts in the grounds of Bloomfield Hospital, Orange. The area is planted with a variety of species of eucalypts from various localities.

The ants were attending *Smicrocotis obscura* (see Figs 1-3). All the eucalypts used as foodplants (*Eucalyptus saligna*, *E. pulverulenta* and other, unidentified species) were smooth trunked, with decorticating bark under which the leafhoppers moved when disturbed. The males were smaller, darker and more numerous than females. Uniformly coloured nymphs were also present and feeding. The ants tapped the leafhoppers with their antennae

and the latter expelled droplets of honeydew every 1-2 minutes and this was vigorously consumed by the ants. Each leafhopper was usually attended by three or four ants but up to 15 ants were seen in attendance of females on occasion. A newly moulted adult which had not yet fed also attracted ants and two ants were seen to be palpating nymphal exuviae. The leafhoppers were not aggregated and remained feeding until midnight, when observations were discontinued. Just before sunrise the leafhoppers had returned to their daytime retreats and few *Camponotus* remained on the eucalypts.

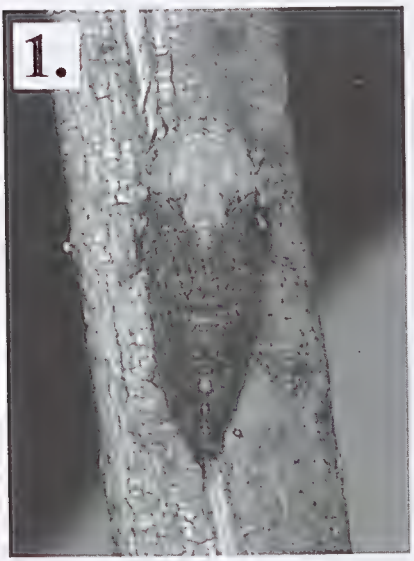
The leafhoppers emerge from under bark before dark and move around the tree, often in a crab-like fashion horizontally. The ants appear to locate the leafhoppers by chance and then attempt to palpate them. No honeydew is produced until the leafhopper starts to feed, which may be some distance from the initial contact point with the ants. At this stage the leafhoppers always have ants in attendance and neither the ants nor the leafhoppers are disturbed by torchlight. The ants were seen at night to be attacking termites on the eucalypts, but not the leafhoppers.

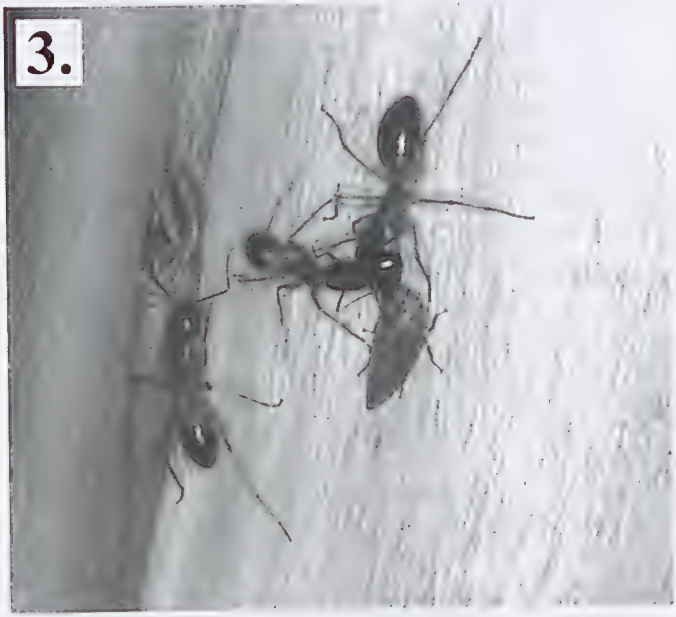
In the summers of 1998 and 1999, *S. obscura* was found again in February on the same eucalypts at Orange, NSW. Efforts were made to find their daytime retreats but without success. A cast nymphal skin which appears to be *S. obscura* was found on a mature eucalypt in nearby natural forest. *Camponotus* nests were abundant in the area though not restricted to near the bases of the eucalypt trees where the leafhoppers were found.

Shortly after the initial observation in 1997, Mr Lindsay Hunt (pers. comm.) also reported almost identical behaviour in *Smicrocotis* sp. at Scott Creek, Mount Lofty Ranges, near Adelaide, South Australia. On an unusually frosty night in late April he found numerous scattered leafhoppers, mostly females, usually attended by four to six *C. consobrinus*. The leafhoppers were feeding mostly on low branchlets. In October 1997, several nymphs were observed feeding in the same locality. In June 1999, large numbers of what appeared to be first instar nymphs of *S. obscura* were found under the bark of the trees at Scott Creek and subsequently also found at Orange. These observations suggest that the species has one generation a year, with eggs hatching in mid to late winter.

Taxonomy

Males of *Smicrocotis* from both Orange and Adelaide were identified by one of us (MF) from Evans' (1966) key to species as *S. sidnica*. The associated females keyed to *S. obscura*. Evans (1966) had reported that he had found only females of *S. obscura*. The three species which were synonymised with *S. obscura* by Evans (1966) are also based on female holotypes. The known distributions of *S. obscura* and *S. sidnica* are almost identical and they have often been collected together, but only males of the latter and only females of the former. It appears that *S. sidnica* and *S. obscura* are forms of the same sexually dimorphic species. Sexual dimorphism is also found in *Stenocotis depressa* and in other taxa of the tribe.





Figs 1-3. (1) Adult female *S. obscura*. (2) Adult female (upper) and nymph (lower) *S. obscura* with attendant ants at Orange, NSW. (3) Adult female *S. obscura* tended by *C. consobrinus* ants at Orange, NSW.

The full synonymy of *S. obscura* is therefore as follows.

Smicrocotis obscura Kirkaldy 1906: 370

Smicrocotis infuscata Distant 1907: 195, synonymised by Evans 1966: 109.

Smicrocotis pallescens Distant 1907: 195, synonymised by Evans 1966: 109.

Smicrocotis projecta Distant 1907: 196, synonymised by Evans 1966: 109.

Smicrocotis sidnica Kirkaldy 1907: 28, **syn. nov.**

Smicrocotis chelonia Evans 1937: 160, synonymised, with *S. sidnica* by Evans 1966: 109.

The validity of *S. brunneus* (Evans 1947) is doubtful since its known distribution (Sydney, NSW) and descriptive features fall within the range of *S. obscura*. Unfortunately, the holotype male lacks an abdomen so it is not possible to examine its genitalia (Day and Fletcher 1994).

Study of the male genitalia (by MF) of the holotype of *S. solomoni* Evans has revealed no differences from males of *S. sidnica* from Orange or Adelaide. However, the spination of the external edge of the hind tibiae differs. *S. obscura* has three small basal spines near the base and four large spurs evenly spaced towards the apex. *S. solomoni* has six spurs more or less evenly spaced and gradually increasing in size from base to apex. The significance of these differences is uncertain. For this reason, synonymy of *S. solomoni* with *S. obscura* is not proposed at this stage. A comprehensive study of the Stenocotini, including molecular, morphological and possibly acoustic data is required also to determine the validity of the genera of the Stenocotini and whether a similar level of synonymy exists within the genus *Kyphocotis* Kirkaldy.

The following species of the tribe Stenocotini, are currently recognised:

Anacotis hackeri Evans 1937

Kyphocotis claudenda (Walker 1858)

Kyphocotis nigrescens (Distant 1907)

Kyphocotis parva Distant 1907

Kyphocotis tessellata Kirkaldy 1906

Kyphoctella distorta Evans 1966

Ledracotis gunnensis Evans 1937

Smicrocotis brunneus (Evans 1947), nomen dubium?

Smicrocotis obscura Kirkaldy 1906

Smicrocotis solomoni Evans 1937

Stenocotis depressa (Walker 1851)

Discussion

This paper provides the first record of a member of the Tribe Stenocotini to be ant attended. However, unlike other species of Cicadellidae in which ant attendance has been observed, particularly the Pogonoscopini (Eurymelidae)

(Evans 1966, Day and Pullen 1999) and *Mymecophryne formiceticola* (Cicadellidae: Xestocephalinae) (Kirkaldy 1906, K. Chandler, pers. comm.), this association appears to be in a very early stage of development. The ants are providentially taking advantage of a food source and, by default, providing some measure of protection to the leafhoppers. There is no question, however, that there is a definite association because the leafhoppers tolerate the attentions of the ants and the ants do not attempt to attack the leafhoppers in the way they attack other insects on the same trees.

Other species of Stenocotini, including *Ledracotis gunnensis* and species of *Kyphocotis* are normally found sheltering under bark during the day and may also be night feeding, although no observation of this and therefore possible ant attendance, has been observed. The exception is *Stenocotis depressa* which is often seen actively moving on the exposed trunk during the day, but may not be feeding at this time.

Acknowledgments

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References

DAY, M.F. and FLETCHER, M.J. 1994. An annotated catalogue of the Australian Cicadelloidea (Hemiptera: Auchenorrhyncha). *Invertebrate Taxonomy* **8**: 1117-1288.

DAY, M.F. and PULLEN, K.R. 1999. Leafhoppers in ant nests: Some aspects of the behaviour of Pogonoscopini (Hemiptera: Eurymelidae). *Victorian Naturalist* **116**: 12-15.

DISTANT, W.L. 1907. Contributions to a knowledge of the Ledrinae. *Annales de la Société entomologique de Belgique* **51**: 185-197.

EVANS, J.W. 1937. Australian leafhoppers (Jassoidea, Homoptera). Part 7. Stenocotidae. *Memoirs of the Queensland Museum* **11**: 157-164.

EVANS, J.W. 1947. A natural classification of leafhoppers (Jassoidea, Homoptera). Part 3. Jassidae. *Transactions of the Royal Entomological Society of London* **98**(6): 105-271.

EVANS, J.W. 1966. The leafhoppers and froghoppers of Australia and New Zealand (Homoptera: Cicadellidae and Cercopidae). *Australian Museum Memoirs* **12**: 1-347.

KIRKALDY, G.W. 1906. Leafhoppers and their natural enemies. Pt IX. Leafhoppers, Hemiptera. *Bulletin of the Hawaiian Sugar Planters Association, Division of Entomology* **1**(9): 271-479.

KIRKALDY, G.W. 1907. Leafhoppers - Supplement (Hemiptera). *Bulletin of the Hawaiian Sugar Planters Association, Division of Entomology* **3**: 1-186.

WALKER, F. 1851. *List of the specimens of Homopterous Insects in the collection of the British Museum* **3**: 637-907.

WALKER, F. 1858. *Supplement. List of the specimens of Homopterous Insects in the collection of the British Museum* **4**: 1-307.

BOOK REVIEW

Silkworm breeding. By Eikichi Hiratsuka. Translated from Japanese. A.A. Balkema, Rotterdam and Brookfield; 1999; vii, 500 pp, 84 b & w pls. Price Stg £60.00, US $99.00. ISBN 905410 7855.

This is a most unusual book on silkworm breeding. It is not, as one might expect from the title (and even by the Publisher's Note following the title page) a treatise on silkworm rearing techniques, but rather an extraordinarily comprehensive account of the different larval and pupal 'races' of silkworms in Japan. These 'races' number an incredible 773; many of the larvae and pupae are figured, the lineages of all are documented and their morphological characteristics recorded. Nearly all carry official names, e.g. Hakuryu, Aojuku and Kuniichi, but some modern ones carry only codes. It should be noted that silkworm races are not races as defined in modern biology but rather denote breeding lineages distinguishable by definable characteristics of larvae and pupae. These characters are mostly colour-based and include a number of rather striking larval patterns. The book is also remarkable for the fact that never once does it mention the name *Bombyx mori*, despite its scientific and exhaustive approach to the subject.

The original Japanese edition of this book appeared in 1969. Its translation into English, 30 years later, is testament to its significance amongst works on sericulture. To my knowledge it is the only book that has ever documented the lineages and morphological characteristics of silkworm 'races' in a comprehensive way, certainly so in English, although there may well be something concerning Chinese sericulture.

There are five chapters, titled as follows: Silkworm races before Meiji Era, Silkworm races of Meiji Era, Silkworm races between Taisho Era (1912-1925) and Showa 11 (1936), Silkworm races for the control of parent egg of F_1 hybrids and finally a chapter detailing breeding lineages titled Breeding Record. The translation is good, and for the most part the text is easily followed. The illustrations, which are all black and white photographs, are satisfactory although figures of some larval 'races' appear inadequate for showing distinguishing characters.

While sericulture remains essentially a hobby in Australia, there is, nevertheless, considerable interest in rearing silkworms among school children. This book, in association with two other comprehensive texts recently published by Balkema (Principles of sericulture and moriculture), provides a wealth of knowledge for anyone seriously interested in silkworms. Sericulturalists throughout the world must be delighted to have this translation available to them.

Max Moulds
Australian Museum

THE MOSQUITO *URANOTAENIA (URANOTAENIA) WYSOCKII* BELKIN (DIPTERA: CULICIDAE) FEEDING ON A FROG *CERATOBACTRACHUS GUENTHERI* BOULENGER (ANURA: RANIDAE)

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Abstract

Feeding of adults of *Uranotaenia wysockii* Belkin on the frog *Ceratobatrachus guentheri* Boulenger is reported for the first time.

Introduction

When first described, adults of *Uranotaenia wysockii* Belkin, a mosquito endemic to the Solomon Islands, were known only from specimens reared from field collected larvae (Belkin 1953). One adult has since been collected in a Malaise trap (Taylor and Maffi 1978). Marks (1960), when reporting *U. albescens* Taylor feeding on the large green tree-frog *Litoria caerulea* (White) in Australia, noted that little was known of the habits of *Uranotaenia* Lynch Arribálzaga, in spite of an almost world wide distribution. Paucity of information still pertains to the fauna of the Australasian Region (Lee *et al.* 1989).

Fig. 1. *Uranotaenia wysockii* feeding on *Ceratobatrachus guentheri*, Kolombangara Island, Solomon Islands. Photo by H.B.Hines.

Of the 26 species in the subgenus *Uranotaenia*, which includes *U. wysockii*, information on blood-feeding has been recorded for only four species. *Uranotaenia albescens* feeds almost exclusively on amphibians (Lee *et al.* 1989). *U. argyrotarsis* Leicester has been observed feeding on the frogs *Rana daemeli* (Steindachner) (Heatwole and Shine 1976) and *Limnodynastes convexiuculus* (Duméril and Bibron) (Marks 1980) and *U. novaguinensis* Peters has also been observed biting *Rana daemeli* (Marks, 1980). *Uranotaenia nivipes* (Theobald) has been found with blood from an ox (one specimen) and from birds (four specimens) (O'Gower 1960).

Feeding of *Uranotaenia wysockii*

On 27 and 29 June 1999, approximately 6 km inland from Iriri village on Kolombangara Island, Western Province, Solomon Islands (8°00'24"S 157°00'54"E, altitude 300-400 m), boldly patterned mosquitoes were observed attacking the frog *Ceratobatrachus guentheri* Boulenger. On 29 June 1999 this event was photographed (Fig. 1) and a single specimen of the highly distinctive *U. wysockii* was captured whilst feeding on the dorsum of *C. guentheri*. The vegetation at this site was primary tropical rainforest with a small permanently flowing stream nearby.

The mosquito specimen has been deposited in The University of Queensland Insect Collection, Brisbane.

References

BELKIN, J.N. 1953. Mosquitoes of the genus *Uranotaenia* in the Solomon Islands (Diptera: Culicidae). *Pacific Science* **7**: 312-391.

HEATWOLE, H and SHINE, R. 1976. Mosquitoes feeding on ectothermic vertebrates: a review and new data. *Australian Zoologist* **19**: 69-75.

LEE, D.J., HICK, M.M., GRIFFITHS, M., DEBENHAM, M.L., MARKS, E.N., BRYAN, J.H. and RUSSELL, R.C. 1989. *The Culicidae of the Australasian Region*. Volume 11. Australian Government Publishing Service, Canberra.

MARKS, E.N. 1960. Mosquitoes biting frogs. *Australian Journal of Science* **23**: 89.

MARKS, E.N. 1980. Mosquitoes (Diptera: Culicidae) of Cape York Peninsula, Australia. Pp 59-76 in *Contemporary Cape York Peninsula*. Ed. N.C. Stevens and A. Bailey. Royal Society of Queensland, Brisbane.

O'GOWER, A.K. 1960. Townsville culicines as possible vectors of dengue and allied viruses among local feral fauna. *Australian Journal of Experimental Biology and Medical Science* **38**: 1-10.

TAYLOR, B and MAFFI, M. 1978. A review of the mosquito fauna of the Solomon Islands (Diptera: Culicidae). *Pacific Insects* **19**: 165-248.

A NEW SPECIES OF *PSALTODA* STÅL, WITH NOTES ON COMPARATIVE MORPHOLOGY AND SONG STRUCTURE (HEMIPTERA: CICADIDAE)

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Abstract

Psaltoda brachypennis sp. nov. is described from Queensland and New South Wales. Information on song, habitat, distribution and season is given and its morphology and song structure are compared with three allied species, *P. claripennis* Ashton, *P. harrisii* (Leach) and *P. plaga* (Walker).

Introduction

Moulds (1984) recognised 11 species in the endemic Australian genus *Psaltoda* Stål, provided a key for their identification and documented their distributions. Moulds (1990) also noted certain morphological characteristics of the genus such as 'a distinct silverish pubescent patch laterally on abdominal tergite 3' and the 'upward turning of the male opercula along at least half the length of their lateral margins' as well as noting that their 'songs are complex and have characteristic yodel-like segments, produced by pulsating upward flexings of the abdomen'.

Young (1972) commented that 'the physical characteristics of the free songs of [cicadas in his study] are remarkably varied and distinct from each other. The songs are also distinct to the human ear and are readily picked out in the field. It seems likely, therefore, that a recording and analysis of the songs might be useful in taxonomic work on Australian cicadas.'

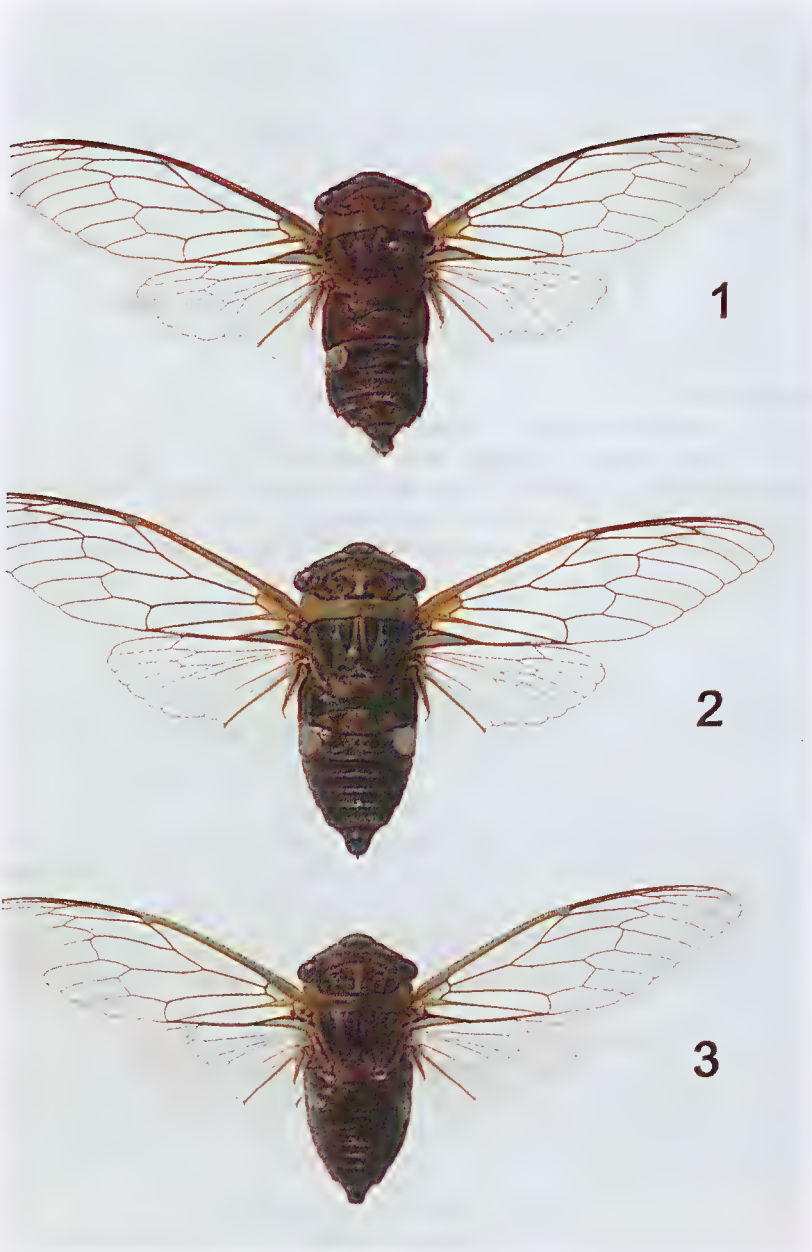
Morphological comparisons made between *P. brachypennis* and three other closely allied species have shown that *P. brachypennis* primarily differs in fore wing and head shape, the positions of opercula relative to metasternum and to some extent in colour and abdominal pubescence. The song of *P. brachypennis* differs from its close allies in structure and component frequencies.

Collections are abbreviated as follows: AE - A. Ewart, Caloundra, Qld; MC - M. Coombs, Brisbane; TL - T. Lambkin, Brisbane; LWP - L.W. Popple, Brisbane; JTM - J.T.St.L. Moss, Brisbane; MSM - M.S. Moulds, Sydney; QM - Queensland Museum, Brisbane; UQIC - University of Queensland, Brisbane.

Psaltoda brachypennis sp. nov.

(Figs 1, 4, 7-9)

Types. Holotype ♂, Gunalda Ra., 25km NW Gympie, Qld, dry vine scrub, 8.ii.1992, J.T. Moss; Queensland Museum reg. no. T62989 (QM). *Paratypes*. QUEENSLAND: 1 ♂, 2 ♀♀, Bulburin State Forest, Central Qld, 29-30. xii. 1993, A. Ewart; 1 ♂, 'The



Figs 1-3. Males: (1) *P. brachypennis*; (2) *P. plaga*; (3) *P. claripennis*. Approximately 1.6x life size.

Figs 4-6. Females: (4) *P. brachypennis*; (5) *P. plaga*; (6) *P. claripennis*. Approximately 1.6x life size.

Amphitheatre', NW of Robinson Gorge NP, 25°12'07"S, 148°59'43"E, open forest, 17.xii.1997, A. Ewart; 1 ♂ 'The Amphitheatre', NW of Robinson [Gorge] NP, 25°12'07"S, 148°59'25"E, vine scrub, 19.xii.1997, A.Ewart (all AE); 1 ♂, 1 ♀, Mt. Maroon, nr Boonah, 28.xii.1993, M. Coombs (MC); 1 ♂, Mt Coot-tha, via Brisbane, 1.ii.1990, T. Lambkin; 1 ♀, The Gap, Brisbane, 26.xii.1973, T. Lambkin (both TL); 1 ♂, 'Grasstree Hill', 5 km N of Monto, 14.xii.1999, L. Popple, J. Moss; 1 ♂, Mt. Marrow via Haigslea, 8.i.2000, L. Popple, J. Moss (both LWP); 1 ♀, Mt. Morgan, 15 km SW Rockhampton, eucalypt forest, 1.i.1973, J.T. Moss; 1 ♀, Bulburin State Forest 391, ca 650 m, 25 km NE Monto via Many Peaks, complex notophyll vine forest, 30.xii.1993, J.T. Moss; 2 ♂♂, Bluff Ra., Biggenden, 65 km W Maryborough, 21.xii.1970, H. Frauca; 1 ♀, Mt. Woowoonga, 664 m, 10 km NE Biggenden, 29-30.i.1972, H. Frauca; 1 ♂, Reservoir Hill, Barnett Rd., Takura, 15 km SW Hervey Bay, remnant dry vine scrub, 2.i.1991, J.T. Moss; 2 ♂♂, 1 ♀, River Heads, 25 km NE Maryborough, vine forest remnant, 26.xii.1990, J.T. Moss; 4 ♂♂, 1 ♀, Gunalda Ra., 25 km NW Gympie, dry vine scrub, 8.ii.1992, J.T. Moss; 5 ♂♂, 1 ♀, Gunalda Ra., 25 km NW Gympie, dry vine scrub, 1.i.1994, J.T. Moss and A. Ewart; 1 ♂, Mt. Marrow via Haigslea, 8.i.2000, J. Moss, L. Popple (all JTM); 1 ♂, Daydream I, [20°15'S, 148°48'E] via Proserpine, 20.ii.1984, R. Eastwood; 1 male, Edungalba nr Duaringa, 22.i.1982, M.S. & B.J. Moulds; 1 ♂, 'Mourangee' Hsd nr Edungalba, softwood scrub, 14.xii.1983, E.E. Adams; 1 ♀, same data but 14.xi.1987; 1 ♂, 2.5 km E of 'Mourangee' Hsd, nr Edungalba, E.E. Adams; 1 ♀, same data but 28.xi.1987; 1 ♂, 4 km N of 'Mourangee' Hsd, nr Edungalba, 23°43'S 149°51'E, 30.i.1987, E.E. Adams (all MSM); 1 ♂, Mt. Cleveland, [19°15'S 147°02'E] 25 km E Townsville, 13.i.1991, A. Graham; 1 ♂, 16 km N Boonah, 27°54'S 152°41'E 3.xii.1997, C.J. Burwell; 1 ♂, Hurdle Gully, 460 m, 24°55'S 150°59'E, 14.8 km WSW of Monto, open forest, M.V. lamp, 19.xii.1997, Burwell, Evans, Ewart; 1 ♀, 'Amphitheatre', 520 m, 25°13'S, 148°59'E, Expedition Ra. N.P., vine scrub, 18.xii.1997, C.J. Burwell, S. Evans; 1 ♀, 'Amphitheatre' campsite, 560 m, 24°54'S 148°59'E, Expedition Ra. N.P., open forest, 18.xii.1997, Burwell, Evans, Ewart; 1 ♀, Black Rock, S of Boonah, vine forest, 4.i.1990, C.J. Burwell; 1 ♀, Perry's Knob, 4 km NE of Rosewood, 200 m, 27°36'S, 152°36'E, vine scrub, 13.i.1999, G. Thompson; 1 ♀, Fletcher (near Stanthorpe), Qld, (no date), E. Sutton (all QM); 1 ♀, Toowoomba, 9.i.1964, J.C. Cardale (UQIC). NEW SOUTH WALES: 1 ♀, Glenugie State Forest, south of Grafton, 19.i.1978, J.T. Moss; 1 ♂, Mt. Kaputar, Nandewar Ra., ca 960 m, 30°12'S 150°5'E, 50 km E Narrabri, open forest, on *Eucalyptus albens*, 7.i.1990, J.T. Moss (both JTM).

Description of Male (Fig. 1)

Head. Vertex olive-green with 0.5 mm wide black line between eyes and ocelli outlined in orange. Postclypeus not prominent, olive-green to yellow-brown with black midline interrupted anteriorly and with approximately nine transverse ridges, finely marked black. Lora covered in fine white pubescence. Anteclypeus brown. Rostrum tan basally, shaft black, almost reaching bases of hind coxae. Antennae black, 0.5-1 mm. Ocelli glassy yellow, within a black fascia. Eyes, in live specimens, brown.

Thorax. Pronotum olive-green, fissures black, median 1 mm wide orange stripe, black outlined laterally and posteriorly, abutting pronotal collar posteriorly, fanning out anteriorly as a wedge into the pronotal disc, covering the middle one third anterior pronotal margin where it is a definite olive-

green in living specimens (rich reddish-brown in dried specimens). Pronotal collar uniformly olive-green. Mesonotum olive-green with two pairs of paramedian black subtriangular fasciae with bases under pronotal collar and apices directed posteriorly, the inner pair outlined in orange, extending one third the length of the mesonotum, the outer pair dissected by irregular greenish brown markings extending close to anterior arms of cruciform elevation. Cruciform elevation uniformly olive-green, paler in dried specimens. A median, black dagger-shaped marking, the shaft between the inner pair of subtriangular fasciae with apex extending anteriorly almost to pronotal collar, and lateral 'deflectors' filling the gap between the anterior arms of the cruciform elevation. Metanotum orange (fading to tan in dried specimens) with posterior and lateral black edging. Thorax below greenish-yellow with copious silvery-white pubescence.

Legs. Coxae and femora shiny yellowish-green. Mid femora with antero-dorsal blackish stripe. Fore tibiae and tarsi brownish-black. Proximal half of mid tibiae green, distal portion and tarsi brownish-black. Hind tibiae and tarsi tan.

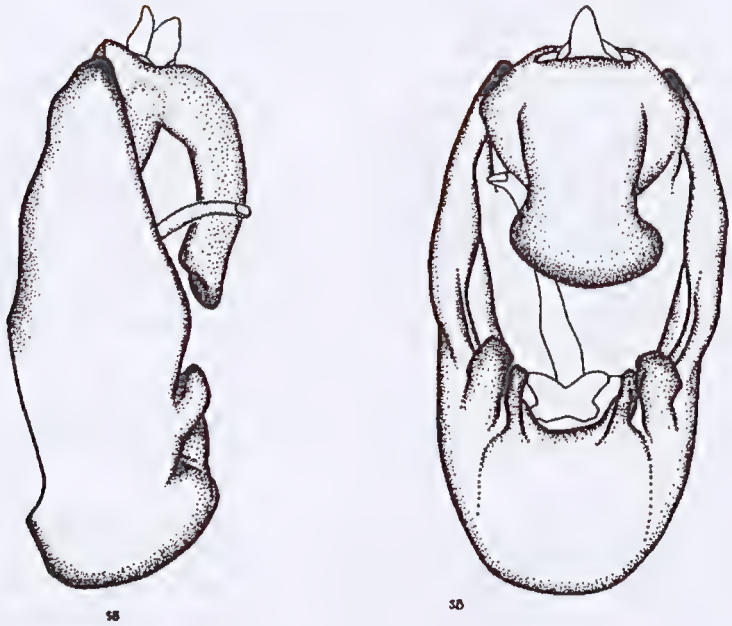
Wings. Hyaline except for slight smokiness of the apical area of both fore and hind wings. No anastomotic (cross-vein) infuscation present. Venation generally reddish-black except for fore wing costa, which is olive-green from base to node. Basal cell olive-green, basal membrane greyish white. Hind wing with narrow brownish-white plaga for length of vein 2A and broader brownish-white plaga for three quarters length of vein 3A.

Opercula (Fig. 9). Somewhat bulbous, uniformly shining greenish-yellow (giving a pseudotranslucent appearance), meeting posteriorly but not overlapping and separated for the most part by the bulbous central projection of the metasternum, and laterally curved upwards with the lateral margins aligned with but largely separated from the lower margins of the tymbal covers.

Abdomen. Tergites generally a rich, dark, reddish-brown with blackish anterior margins and covered with scattered silvery-white pubescence. A large oval p atch of silvery-white pubescence laterally on tergite 3. Sternite I obscured by opercula. Sternite II black and III-VII translucent orange-brown. Sternite VIII much paler and opaque. White spiracles are sometimes obscured by shiny white pubescence.

Genitalia (Figs 7, 8). Pygofer black basally, centrally and marginally, with pale orange lateral fascia. Uncus pale brown, broad, with expanded, asymmetrical, rounded, bilateral lobes at apex. Aedeagus smooth, slender, parallel-sided, gently curved.

Female (Fig. 4). Similar to male. Abdominal segment 9 orange with lateral black triangular fascia each side extending for half the length, the base of each fascia hidden under tergite 8. Apical spine black. Sternite II black,



Figs 7-8. *P. brachypennis*, male genitalia: (7) pygofer, left lateral view; (8) pygofer, ventral view.

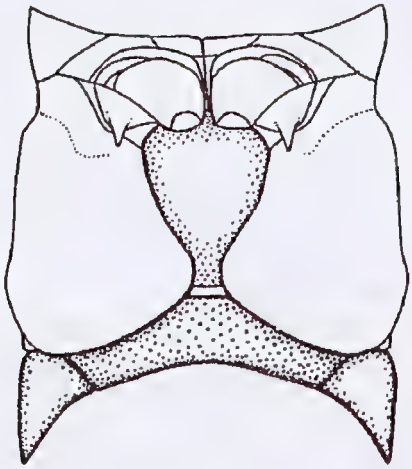


Fig. 9. *P. brachypennis*, opercula and metasternum of male.

remainder tan. Sternite VII with tiny (0.3 mm) brownish-black dot each side. Ovipositor brownish-black.

Dimensions. Range and average for 26 males and 13 females. Length of body: males 27.0-34.0 mm (mean 31.3 mm), females 24.0-30.0 mm (mean 25.6 mm). Length of fore wing: males 34.0-41.0 mm (mean 37.3 mm), females 33.0-38.0 mm (mean 35.7 mm). Width of fore wing: males 12.0-14.0 mm (mean 13.2 mm), females 11.5-14.0 mm (mean 12.6 mm). Width of head: males 12.0-13.0 mm (mean 12.4 mm), females 11.5-12.5 mm (mean 12.0 mm). Width of pronotum: males 11.0-12.0 mm (mean 11.7 mm), females 11.0-12.0 (mean 11.4 mm).

Etymology. The specific name is derived from the Greek *brachys* meaning short and the Latin *penna* meaning a wing or feather.

Morphological comparisons with similar species

Forewing. Length/width ratios for males and females of *P. brachypennis* were compared with those of the three species considered most similar to it, *P. claripennis* Ashton, *P. harrisii* (Leach) and *P. plaga* (Walker). Length measurements were taken from the extreme base of the wing to the apex and width measurements were taken from the costal node to the junction of vein CuA1 with the ambient vein. The results show no significant differences between *P. claripennis*, *P. harrisii* and *P. plaga*, but there is clearly a difference between these and *P. brachypennis*, which is statistically significant (Tables 1 and 2). Note coincident mean for both sexes of *P. brachypennis* and nil overlap between this and allied species (Fig. 10).

Table 1. Comparative measurements of *P. brachypennis* and three similar species (Length/width ratios of forewings).

Species	Gender	No. of specimens	Mean ± S.E.
P. brachypennis	♂	26	2.84 ± 0.029
	♀	13	2.84 ± 0.047
P. claripennis	♂	10	2.97 ± 0.038
	♀	10	3.05 ± 0.041
P. harrisii	♂	10	3.00 ± 0.028
	♀	10	3.05 ± 0.040
P. plaga	♂	11	3.08 ± 0.035
	♀	10	3.02 ± 0.029

Male underside. The metasternal midline bulge is very prominent in *P. brachypennis* and *P. harrisii*, but less obvious in *P. plaga* and *P. claripennis*. The opercula in the former two species either just meet in ventral midline or there is clear separation. In *P. plaga* and *P. claripennis* there is never any separation, they either overlap or at least clearly meet in midline (Fig. 9).

Table 2. Two-tailed *t*-test results for measurement comparisons. (Critical *p*-value is 0.05).

Comparisons of *P. brachypennis* with:	Gender	Total degrees of freedom	*p*-value
P. claripennis	♂	34	0.02
	♀	21	0.004
P. harrisii	♂	34	0.003
	♀	21	0.005
P. plaga	♂	35	0.00004
	♀	21	0.007

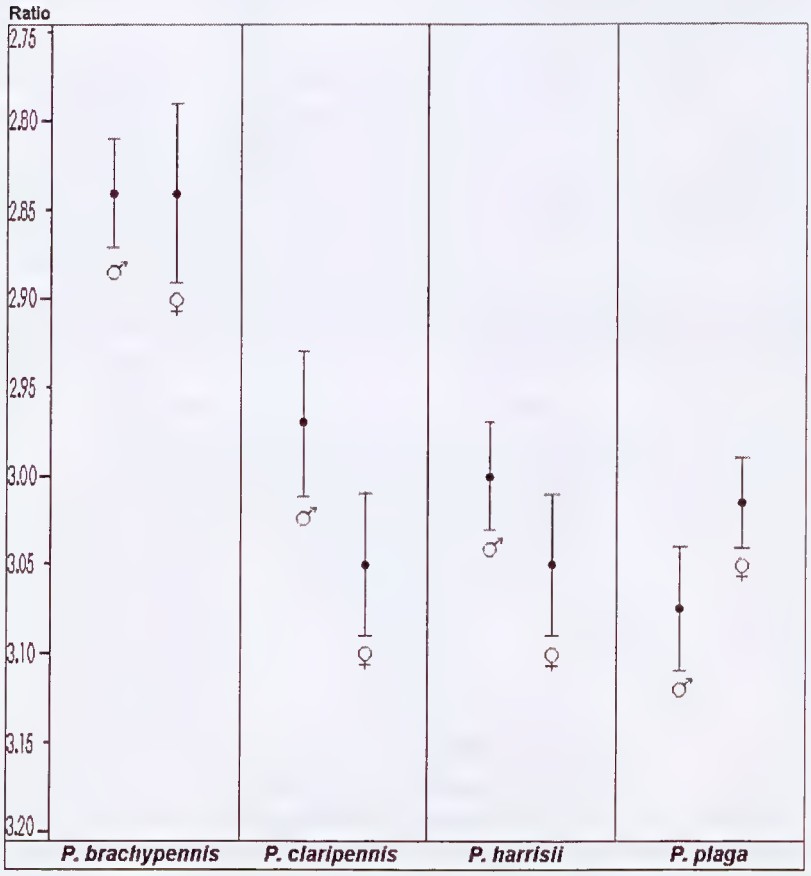


Fig. 10. Mean wing length/width ratios (± standard error) for both sexes of four species of *Psaltoda*.

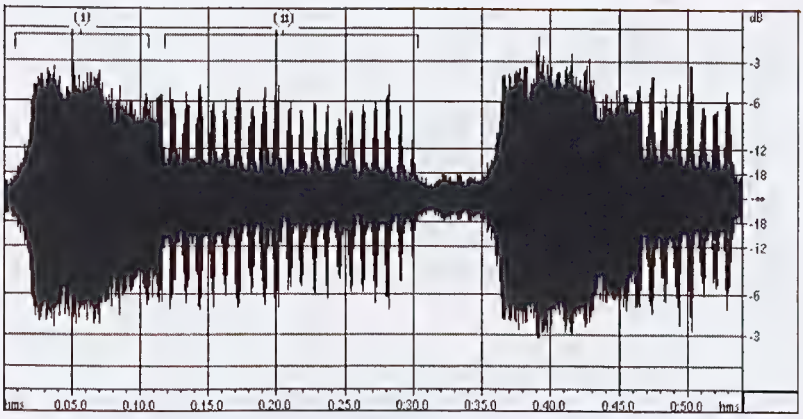


Fig. 11a

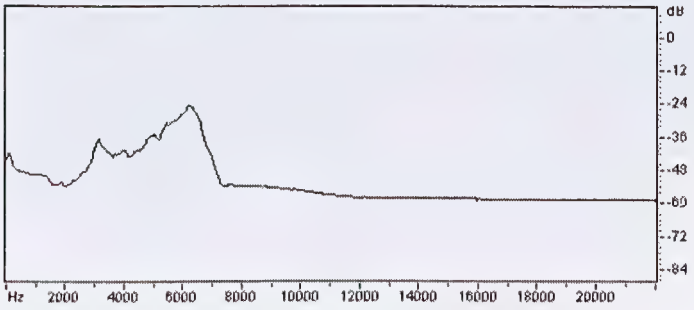


Fig. 11b

Fig. 11. *Psaltoda brachypennis*. (a): Oscillogram of free calling song showing (i) continuous ('roaring') phase and (ii) revving phase. Recorded by J.T.St.L. Moss at Mt. Coot-tha Botanic Gardens, Brisbane on 21. Jan. 1987, with a Marantz Superscope cassette tape recorder and digitized using *Cool Edit 2000* analysis program (Syntrillium software company). (b): Blackmann-Harris linear frequency analysis of Fig. 11a recording.

Wings. In *P. harrisii* and *P. claripennis* the wings are clear. In *P. plaga* they are clear, but with infuscation of the first two apical (anastomotic) cross veins in the fore wing. *P. brachypennis* has no infuscation, but has a slight smokiness of the apical cellular areas of both fore and hind wings. In addition, the basal cells of *P. brachypennis* and *P. plaga* are opaque green, whereas that of *P. claripennis* is translucent green and *P. harrisii* is translucent yellow (Figs 1-6).

Head. Viewed dorsally, *P. harrisii*, *P. claripennis*, and *P. plaga* have an acute-angled head due to prominent postclypeus. *P. brachypennis* is generally more obtuse or blunt (Figs 1-6)

Male abdomen. The lateral aspect of tergite 3 has a patch of shiny silvery-white pubescence in *P. brachypennis*, but is yellow in *P. harrisii*, pale gold in *P. plaga* and silvery-gold in *P. claripennis* (Figs 1-3).

Female abdomen. The truncate appearance of the abdomen of female *P. brachypennis* is very distinctive. The abdomens of female *P. plaga* and *P. claripennis* are more gradually tapered, giving a more 'pointed' appearance (Figs 4-6).

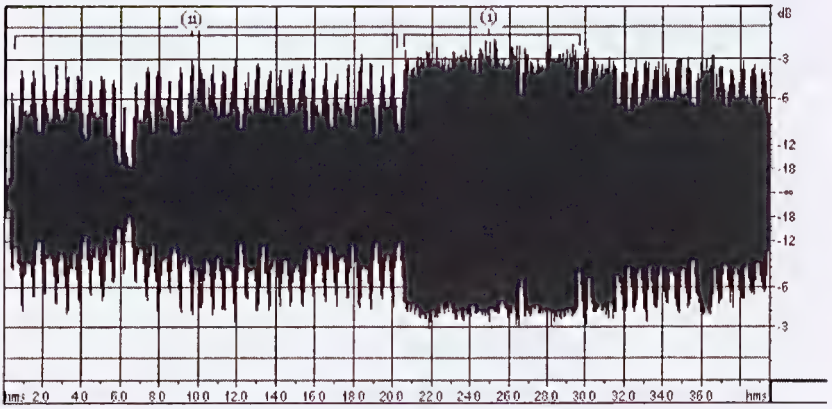


Fig. 12a

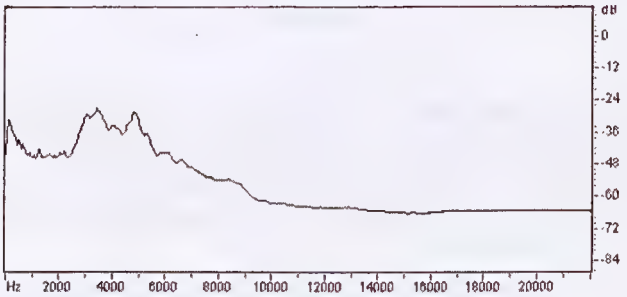


Fig. 12b

Fig. 12. *Psaltoda plaga.* (a): Oscillogram of free calling song showing (i) continuous ('whining') phase and (ii) revving phase. Recorded by J.T.St.L. Moss at Girrahween Park, Earlwood, Sydney, ca 1970, on a Sony reel-to-reel tape recorder and digitized as per Fig. 11a. (b): Blackmann-Harris linear frequency analysis of Fig. 12a recording.

Body colour. *P. brachypennis* in life is a dull olive-green which differs from the much brighter green tones of *P. claripennis* and green individuals of *P. plaga* (Figs 1-6). *P. harrisii* is predominantly brownish-black on a yellowish background (see Moulds 1990 for photo).

Genitalia. The male genitalia do not differ significantly from other *Psaltoda* species. There are only minor differences in the shape of the expanded apex of the uncus.

Song structure of *P. brachypennis*

The calling song of *P. brachypennis* is similar to at least three other sympatric *Psaltoda* species which have both continuous and revving phases. It starts abruptly with a loud continuous 'roaring' phase similar to that of *P. claripennis* and *P. plaga* but somewhat more melodious. The revving phase has short (0.5-0.6 sec.) phrases at 1.0 sec. intervals and these are audibly clearer and less obscured by a softer background continuous

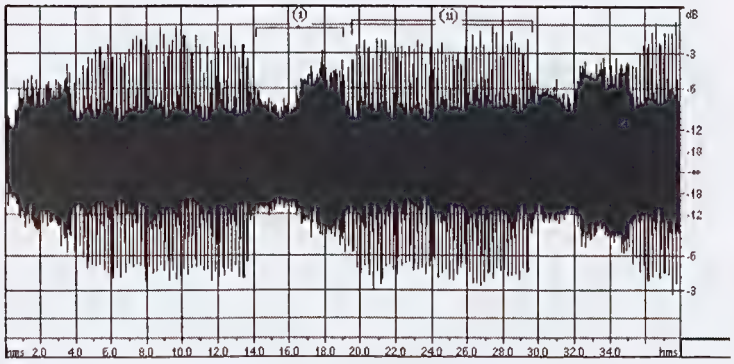


Fig. 13a

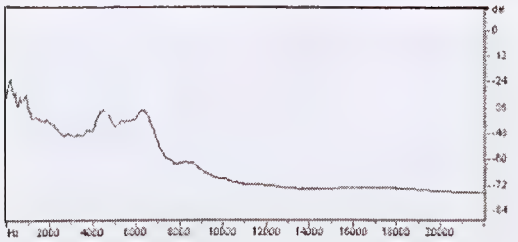


Fig. 13b

Fig. 13. *Psaltoda claripennis.* (a): Oscillogram of free calling song showing (i) continuous ('rattling') phase and (ii) fast revving ('clanging') phase. Recorded by J.T.St.L. Moss at Rockhampton, Qld, in Dec. 1981, on a Sony reel-to-reel tape recorder and digitized as per Fig. 11a. (b): Blackmann-Harris linear frequency analysis of Fig. 13a recording.

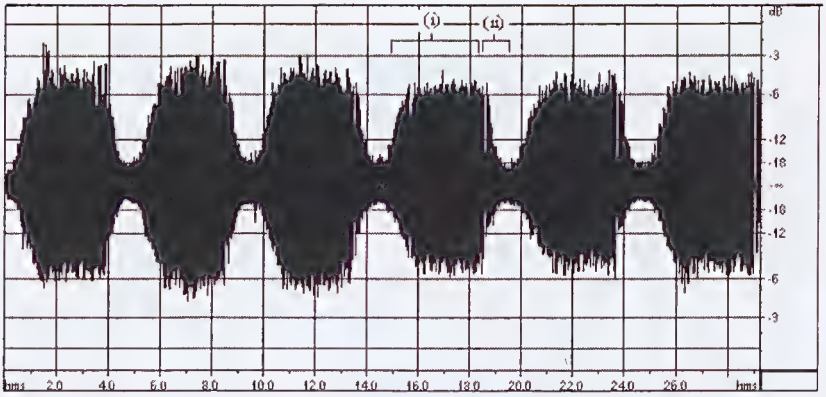


Fig. 14a

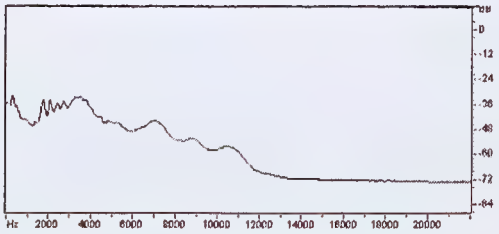


Fig. 14b

Fig. 14. *Psaltoda harrisii.* (a): Oscillogram of free calling song showing (i) initial rising vibrato phase (continuous crescendo) and (ii) abrupt falling phase (fast decrescendo). Recorded by J.T.St.L. Moss at Narrabeen, Sydney, ca 1970, on a Sony reel-to-reel tape recorder. Other details as in above Figures. (b): Blackmann-Harris linear frequency analysis of Fig. 14a recording.

component, which is more a feature of the song of *P. plaga*. The latter species also has 0.5-0.6 sec. phrases, however these are repeated at 0.6 sec. intervals, which produces an audibly 'faster' song than *P. brachypennis*. However, unlike *P. plaga*, revving with *P. brachypennis* does not always occur with each episode of song. On the other hand *P. claripennis* has much shorter individual rev phrases of 0.05 sec. repeated at intervals of 0.2 sec. which produces an even faster song reminiscent of a clanging sound. The song structure of *P. harrisii* is notably different, exhibiting a modified song pattern with an amplitude modulated rising and falling vibrato effect, which can be described as 'rattling' and soft 'sighing'. It lacks a revving phase, but has long crescendo and abrupt decrescendo components (Young, 1972).

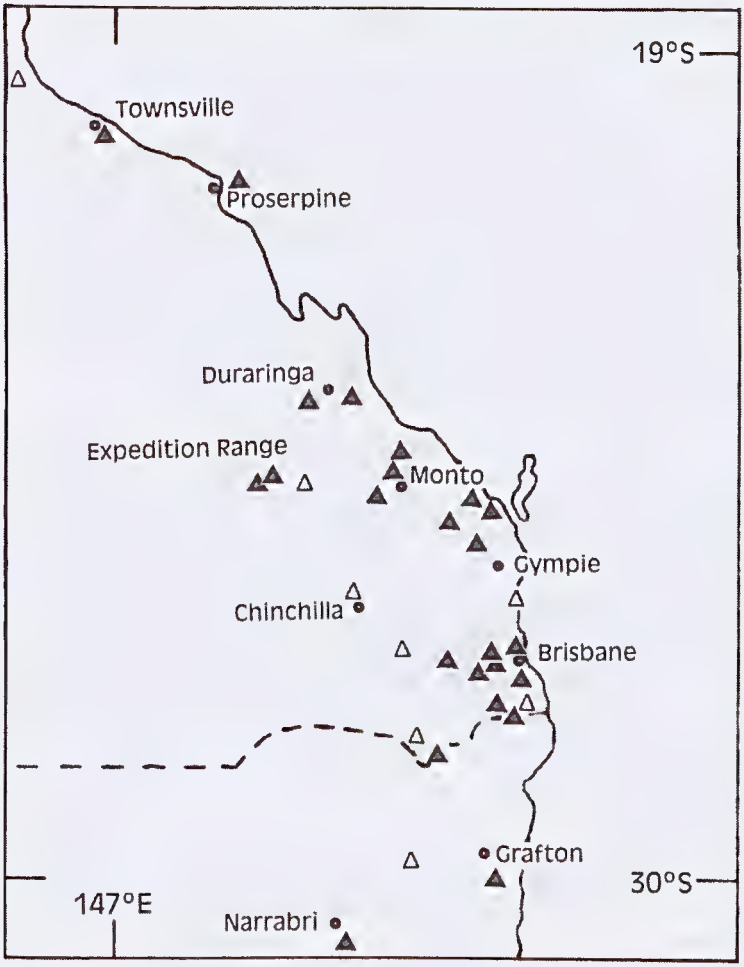


Fig. 15. Distribution of *P. brachypennis*: locations where specimens have been collected (▲); locations of tape recordings and/or aural records which have been confirmed by at least two observers (Δ); geographical reference points (●).

These structural differences can be seen on the oscilloscopic tracings (Figs 11a-14a). The song quality is audibly different, and the frequency analyses show notable harmonic frequency component differences between *P. brachypennis* and its allies (Figs 11b-14b). Young and Josephson (1983) have further analysed both the calling and distress songs of *P. plaga* (as *P. argentata*), *P. claripennis* and *P. harrisii*.

Notes on habitat, distribution and season

The diverse vegetation preference of *P. brachypennis* is most unusual, being found in the following habitats: coastal and montane complex notophyll vine forest (both tropical and subtropical), softwood and dry vine scrubs, and eucalypt dominant dry and wet sclerophyll forests (both montane and coastal). It is usually a mid to late summer species both in the north and south, and along the coast and inland, although in inland central Qld it has been recorded as early as the 14th of November. This is a widespread species, with records along the Queensland coast south from Townsville to Grafton in north-eastern New South Wales, and inland south from Duaringa and the Expedition Range of central Qld to Mt Kaputar near Narrabri on the north-eastern slopes of NSW (Fig. 15). It is nowhere common and there are few specimens in collections, with barely more than four dozen known, and these having mostly been hand collected, as the species appears not to be readily attracted to light.

Its resemblance to some of the other *Psaltoda* species (in song and morphology) may have accounted for it being overlooked. Its habit of resting high up on trees has ensured that voucher specimens for visual and auditory records are often difficult to obtain. However, in addition to the type series locations, reliable records do exist from Crystal Ck. in Paluma Range north-west of Townsville, Isla Gorge National Park near Theodore, Chinchilla, Noosa National Park, Lake Broadwater via Dalby, Upper Tallebudgera Ck. west of Burleigh Heads and Sundown National Park near Texas in Queensland and Gibraltar Range west of Grafton in New South Wales. Song recordings have been obtained from some of these sites. It is puzzling why a species with a wide distribution and a diverse habitat preference should be in such low numbers in relation to the relative abundance of its close allies.

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References

MOULDS, M.S. 1984. *Psaltoda magnifica* sp. n. and notes on the distribution of other *Psaltoda* species (Homoptera: Cicadidae). *General and Applied Entomology* **16**: 27-32.

MOULDS, M.S. 1990. *Australian Cicadas*. New South Wales University Press, Kensington, NSW; x + 217pp.

YOUNG, D. 1972. Analysis of songs of some Australian cicadas (Homoptera: Cicadidae). *Journal of the Australian Entomological Society* **11**: 237-243.

YOUNG, D. and JOSEPHSON, R.K. 1983. Mechanism of sound-production and muscle contraction kinetics in cicadas. *Journal of Comparative Physiology* **152**: 183-195.

THE LIFE HISTORY OF *PHILIRIS PHILOTAS PHILOTAS* (C. FELDER) (LEPIDOPTERA: LYCAENIDAE)

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Abstract

The life history of the Indonesian lycaenid butterfly *Philiris philotas philotas* (C. Felder) is described and illustrated. The larval food plant is *Macaranga* sp. nr *aleuritoides* F. Muell. (Euphorbiaceae).

Introduction

The genus *Philiris* Röber contains 64 named species (Sands 1986, Ring and Olive 1997) although more are likely to be discovered, especially in mainland New Guinea where most of the known taxa occur (Parsons 1991, 1998). The genus extends from the Moluccas [Maluku] through mainland New Guinea to the Bismarck Archipelago and into northern Australia (Parsons 1998).

Biological information for the genus is limited and outside Australia the early stages and larval food plants have been recorded only for *P. moira moira* (Grose-Smith) (Forbes 1977), *P. ziska* (Grose-Smith), *P. intensa* (Butler), *P. dinawa* (Bethune-Baker), *P. agatha* (Grose-Smith), *P. helena* (Snellen), *P. diana* Wind & Clench, *P. violetta* (Röber), *P. praeclara* Tite and *P. harterti* (Grose-Smith) (Parsons 1984, 1991, 1998). Listed food plants belong to the families Moraceae, Urticaceae, Euphorbiaceae and Lauraceae (Forbes 1977, Parsons 1984, 1991, 1998).

During June and July 1996, the early stages of *P. philotas philotas* (C. Felder) were discovered on the Indonesian islands of Ambon and Seram in the Moluccas. Sands (1981) examined 16 males and 6 females from Ambon and the taxon is otherwise known from Seram, Buru, Goram and Watubela Islands, all in the southern Moluccas. A second subspecies, *P. p. obiana* Tite, is known from Obi, central Moluccas.

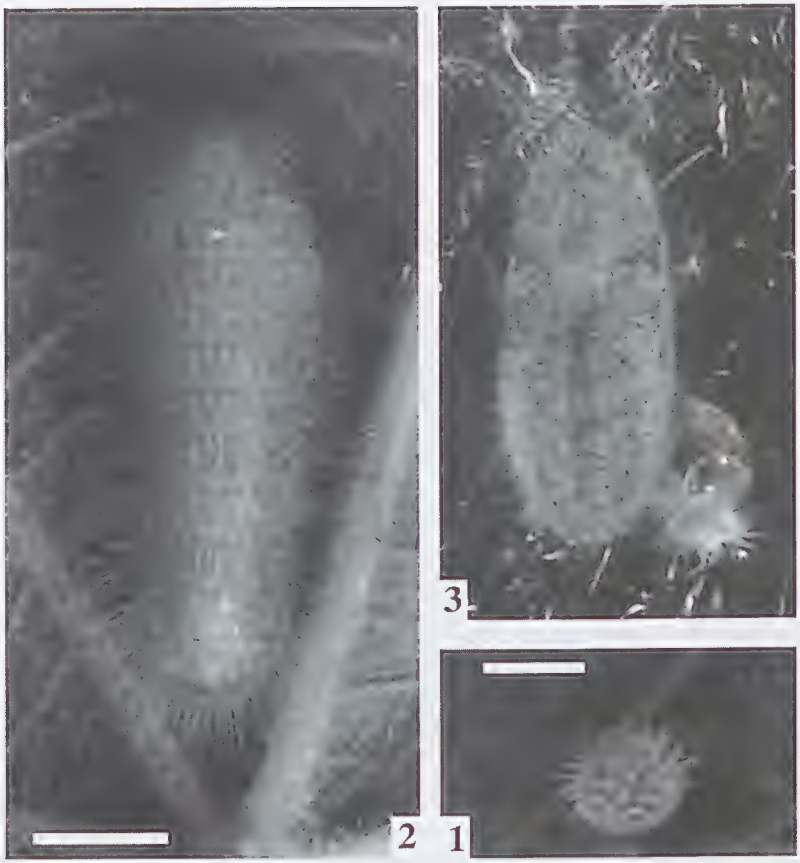
Life history

Food plant. *Macaranga* sp. near *aleuritoides* F. Muell. (Euphorbiaceae).

Egg (Fig. 1). Diameter 0.65 mm; white, spherical, with numerous long (up to 0.08 mm) spines that are flattened towards the egg periphery.

Larva. First instar: length 1.1 mm, width 0.55 mm; hairy, pale yellow-green with darker dorsal band. Third instar: length 8.1 mm, width 3.2 mm; hairy, flattened laterally, green with indistinct yellow dorsal stripes. Final instar (Fig. 2): length 14.2 mm, width 5.0 mm; similar to third instar but with arcuate yellow cusps, forming up to six parallel dorsal stripes.

Pupa (Fig. 3). Length 9.4 mm, width 4.1 mm; strongly oval in shape, hairy, green with darker dorsal band bounded by yellow on abdomen, posterior lateral margins of thorax dark green.



Figs 1-3. Early stages of *Philiris philotas philotas*. (1) egg; (2) mature larva, dorsal view; (3) pupa, dorsal view. Scale bars (1) = 0.4 mm; (2, 3) = 2 mm.

Discussion

The eggs were laid singly on the underside of leaves of the food plant, usually beside a vein. Young larvae fed on the epidermis on the underside of mature leaves, producing a distinctive scarring in affected leaves. Mature larvae produced a series of holes, usually adjacent to the midrib. Pupation occurred head upwards, attached by cremaster and central girdle on the underside of a mature leaf of the food plant. The dorsal abdominal brown patch, present in pupae of several *Philiris* species, appears to be poorly developed in *P. philotas*.

Larvae most commonly were found on the *Macaranga* food plants growing in well-lit clearings on steep hillsides and limestone karsts. *Macaranga* species have been recorded as food plants for *P. agatha* and *P. helena* by Parsons (1984, 1991, 1998) in Papua New Guinea and for *P. sappheira*

Sands by Ring and Olive (1997) and *P. nitens* (Grose-Smith) by Valentine (1988) and Muller (1998) in northern Queensland.

Adults of both *P. philotas* and *P. ilias* (C. Felder) were collected together in secondary rainforest and settled 2-8 m above the ground. Males exhibited territorial behaviour in strong sunlight, returning to perches head downwards on the tips of leaves. Both sexes were taken at the blossom of an *Acmena* species, together with *Bindahara phocides* (Fabricius) and species of *Deudorix* Hewitson.

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References

FORBES, G.R. 1977. The life history and polymorphic female of *Philiris moira moira* (Grose-Smith) (Lepidoptera: Lycaenidae) from Papua New Guinea. *Journal of the Australian Entomological Society* **16**: 273-275.

MULLER, C.J. 1998. New larval food plant records for butterflies (Lepidoptera) in northern Queensland. *Australian Entomologist* **25**(2): 33-38.

PARSONS, M.J. 1984. Life histories of four species of *Philiris* Röber from Papua New Guinea. *Journal of the Lepidopterists' Society* **38**: 15-22.

PARSONS, M.J. 1991. *Butterflies of the Bulolo-Wau Valley*. Bishop Museum Press, Honolulu; 280 pp, 27 pls.

PARSONS, M.J. 1998. *The butterflies of Papua New Guinea. Their systematics and biology*. Academic Press, London; xvi+736 pp, xxvi+136 pls.

RING, L.R. and OLIVE, J. 1997. The specific status of *Philiris sappheira* Sands (Lepidoptera: Lycaenidae) with description of a new subspecies from Australia. *Australian Entomologist* **24**(2): 65-71.

SANDS, D.P.A. 1981. *The ecology, biogeography and systematics of the tribe Luciini (Lepidoptera: Lycaenidae)*. Unpublished PhD thesis, University of Queensland, Brisbane.

SANDS, D.P.A. 1986. A revision of the genus *Hypochrysops* C. & R. Felder (Lepidoptera: Lycaenidae). *Entomonograph* **7**: 1-116.

VALENTINE, P.S. 1988. Some new larval food plants for north Queensland Lycaenidae (Lepidoptera). *Australian Entomological Magazine* **14**: 89-91.

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ARCHANGELSKY, M.
1998 Phylogeny of Hydrophiloidea (Coleoptera: Staphyliniformia) using characters from adult and preimaginal stages. *Syst. Ent.* **23:** 9-24.

AZEVEDO, C.O.
1999 A key to world species of Scolebythidae (Hymenoptera: Chrysidoidea), with description of a new species of *Dominibythus* from Brazil. *J. Hym. Res.* **8:** 1-5.

BELSHAW, R., FITTON, M.G., HERNIOU, E., GIMENO, C. and QUICKE, D.L.J.
1998 A phylogenetic reconstruction of the Ichneumonoidea (Hymenoptera) based on the D2 variable region of 28S ribosomal RNA. *Syst. Ent.* **23:** 109-123.

BEUTEL, R.G., MADDISON, D.R. and HAAS, A.
1999 Pylogenetic analysis of Myxophaga (Coleoptera) using larval characters. *Syst. Ent.* **24:** 171-192.

BROWNE, D.J. and SCHOLTZ, C.H.
1999 A phylogeny of the families of Scarabaeoidea (Coleoptera). *Syst. Ent.* **24:** 51-84.

CARLE, F.L. and LOUTON, J.A.
1994 The larva of *Neopetalia punctata* and establishment of Austropetaliidae fam. nov. (Odonata). *Proc. ent. Soc. Wash.* **96:** 147-155.

CLARK SELLICK, J.T.
1998 The micropilar plate of the eggs of Phasmida, with a survey of the range of plate form within the order. *Syst. Ent.* **23:** 203-228.

COMMON, I.F.B.
1997 Oecophorine genera of Australia II. The *Chezala*, *Philobota* and *Eulechria* groups (Lepidoptera: Oecophoridae). *Monog. Aust. Lepid.* **5:** xvi + 407.

CRANSTON, P.S. and EDWARD, D.H.D.
1999 *Botryocladius* gen. n.: a new transatlantic genus of orthocladiine midge (Diptera: Chironomidae). *Syst. Ent.* **24:** 305-333.

DANFORTH, B.N.
1999 Phylogeny of the bee genus *Lasioglossum* (Hymenoptera: Halictidae) based on mitochondrial COI sequence data. *Syst. Ent.* **24:** 377-393.

GREENSLADE, P.J.M.
1999 What entomologists think about listing species for protection: a survey of butterfly specialists in Australia. Pp. 345-349 *in* Ponder, W.F. and Lunney, D. (eds.), *The other 99%. The conservation and biodiversity of invertebrates.* Royal Zoological Society of N.S.W.: Mosman.

HARBACH, R.E. and KITCHING, I.J.
1998 Phylogeny and classification of the Culicidae (Diptera). *Syst. Ent.* **23:** 327-370.

JOHNS, P.M.
1997 The Gondwanaland weta: family Anostostomatidae (formerly in Stenopelmatidae, Henicidae or Mimnermidae): nomenclatural problems, world checklist, new genera and species. *J. orthopt. Res.* **6:** 125-138.

KIMSEY, L.S.
1999 Revision of the Australian tiphiid genus *Leiothynnus* (Hymenoptera: Tiphiidae: Thynninae). *J. Hym. Res.* **9:** 18-28.

KITCHING, R.L.
1999 Adapting conservation legislation to the idiosyncrasies of the arthropods. Pp. 274-282 *in* Ponder, W.F. and Lunney, D. (eds.), *The other 99%. The conservation and biodiversity of invertebrates.* Royal Zoological Society of N.S.W.: Mosman.

LESCHEN, R.A.B.
1999 Systematics of Nitidulinae (Coleoptera: Nitidulidae): phylogenetic relationships, convexity and the origin of phallalophagy. *Invert. Taxon.* **13:** 845-882.

MACKINTOSH, J.A., FLOOD, J.A., VEAL, D.A. and BEATTIE, A.J.
1999 Increase in levels of microbiota recoverable from male and larval *Myrmecia gulosa* (Fabricius) (Hymenoptera: Formicidae) following segregation from worker ants. *Aust. J. Ent.* **38:** 124-126.

MADDISON, D.R., BAKER, M.D. and OBER, K.A.
1999 Phylogeny of carabid beetles as inferred from 18S ribosomal DNA (Coleoptera: Carabidae). *Syst. Ent.* **24:** 103-138.

MAEYAMA, T., MACHIDA, M. and TERAYAMA, M.
1999 The ant-parasitic genus *Rhipipalloidea* Girault (Hymenoptera: Eucharitidae), with a description of a new species. *Aust. J. Ent.* **38:** 305-309.

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